

SUMMARY OF THE REPORT ON THE POMELOE MOTH.

AT the request of the British Resident of Pérak, I made an enquiry into the cause of the destruction of all the pomeloe fruit grown in the Residency gardens at Kwala Kangsa, and have ascertained, from actual observations and breeding experiments, that it is primarily to the attacks of the caterpillars of a small moth, that the loss is due.

The life history of this insect is, as far as I have been able to observe it, as follows :—

The eggs are laid singly and in small irregular patches on the lower side of the fruit, and when they hatch out, the young caterpillars eat their way into the fruit making a number of minute holes through the rind, generally over an area of about the size of a shilling. The pith under this patch is riddled with holes, and gum is often subsequently found, both in the cavities of the rind, and also on the outside of the fruit.

As the caterpillars increase in size, they eat their way through and through the fruit, and make holes through the rind to eject refuse, and also possibly to obtain air. To these holes uneatable portions of the fruit and faecal pellets are carried by the caterpillars and ejected.

The caterpillars, which are active, quick-moving insects, jump and twist when touched, and, for caterpillars, can progress with considerable speed. On arriving at maturity, they leave the fruit, and descending to the ground bury themselves in the earth to undergo the change into the pupa state; the caterpillars make in the earth cells of agglutinated earth, lined with white silk; they measure 0.7 inch in length, 0.4 inch in breadth, and 0.3 inch in depth.

On the twelfth day after quitting the fruit, the transform-

ation is complete, and the moth forces its way through the cell and up out of the earth.

The perfect insect is about an inch across the wings and of a warm brown colour with shadings of silvery grey. In the day time it is very quiet and sits usually on the earth of the breeding cages, the head and forepart of the body being much raised, and the antennæ laid back on the wings, which are closed and folded closely over the body. When in this position, it is a very inconspicuous object, both as regards colour and form. At night it seems to be lively and is possessed of fairly good powers of flight.

The first four moths I raised all died in a little over two days, and though they consisted of two of each sex, no eggs were laid. On dissection of the females I found the eggs to be immature and few in number, and deduced from their state, that the insect does not deposit its eggs until some days after leaving the chrysalis and that during that time it needs food to enable it to perpetuate its species.

With the next brood of moths I put various fruits, but none of these seemed to their taste, for though they lived for five or six days, and laid a few eggs, none of these proved fertile. In all I raised over thirty of these insects without getting one egg that would hatch.

It seems quite possible that as the fruit on which they feed during the caterpillar stage is seasonal and that there are periods of months at a time during which no food is available that the moths are long-lived, and until their natural food during the imago portion of their lives is discovered, attempts at artificial breeding will be unsuccessful.

DESCRIPTION.

Egg.—Oval, dirty white, translucent with fine raised, irregular network covering surface. Length .04 inch, and breadth .025 inch. When laid they take the form of flattened ovals with the lower side following the shape of the object on which they are laid, and the upper surface convex.

Larva.—General colour bluish-green, tinted above with

pinkish bronze. The four anterior segments being less tinted than the remainder, the young are almost wholly of a rather dull pink. Length of adult .86 inch, breadth .63 inch.

Pupa.—General colour warm brown, darkening towards the tail, wing sheaths dull green for the first few days, after which they become dark brown. A dark median line from tail to thorax on the dorsal aspect. Length .5 inch breadth .17 inch.

EFFECT ON THE FRUIT.

The caterpillar of the pomeloe moth is able to pierce uninjured the natural defences of the fruit, disregarding both the pungent oil of the rind, and the thick layer of pith beneath it, it reaches the cellular portion of the fruit, which it tunnels through and through in all directions passing through and through in all directions, passing through the seeds if they happen to be in its line, but apparently not seeking them out. Fæcal matter is deposited in the burrows, and decomposition as a consequence quickly sets in on its walls. Under the microscope, the fluid contents of any cell which has had its containing sac broken by the passage of the caterpillar is seen to be teeming with bacterial life of many kinds. Carefully detaching a sac adjoining one that had been broken by a caterpillar, but which was in itself quite perfect, and microscopically examining its contained fluid, there appeared many bacteria. The most frequent form being masses of cocci; many other forms were present, but in smaller numbers.

An oval saccharomyces was very plentiful in the injured cells, and is the probable cause of the acid fermentation which takes place in them. It was not present in the adjoining unbroken ones. Presumably the smaller forms only can pass from cell to cell through the connecting vessels.

It is probably to this secondary attack of micro-organisms that the premature ripening and falling of the fruit may be ascribed, more than to the actual injury done by the caterpillars themselves; other insects taking advantage of the holes made by the caterpillars through the rind can enter the fruit

and lay their eggs in the pith and pulp, with the result that large rotten patches spread from the entrance and exit holes. These insects are two or three species of flies, and a small brown beetle, all of which are attracted by any decaying fruit.

PREVENTIVE MEASURES.

The life history of the pomeloe moth shows that there is only a period of its existence when there is any hope of destroying it in useful numbers, and that is when it is in the caterpillar stage inside the fruit. The eggs are small and so like the oil cells on which they are laid, that without a lens it is difficult to see them; in the pupa state, which is passed beneath the ground, they are well out of reach, and in the perfect stage, being strictly nocturnal and very inconspicuous, there would be little chance of doing any good.

The only suggestion that I can make is to destroy all fruit that is seen to be inhabited by the caterpillars, or which falls from the trees. The destruction of the fruit which falls is of importance not only as a means of killing the insects contained in it, but also as preventing its serving for the rearing of another brood.

As the eggs seem to be laid only on the fruit itself, it would appear that if the young fruits are put into bags, that they would have a chance of arriving at maturity.

I am inclined to think that the wild species of *citrus*, known by the native name of *limau kerbau*, and which is apparently nearly allied to the pomeloe, *citrus decumana*, is the natural food of these caterpillars, as it is a fairly common tree in the jungles of some parts of Pérak.

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